REMARKS

Claims 19, 20, 21, 28, 32, and 34 have been amended. Upon entry of this amendment, claims 19-22 and 26-35 will be pending in the application.

Rejection under 35 U.S.C. §102(b)

Applicant respectfully requests reconsideration of the rejection of claims 19 and 20 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,230,777 to Jarrell ("Jarrell").

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989). Applicant respectfully submits that the invention as defined in claims 19 and 20 is not anticipated by Jarrell.

The invention of claims 19 and 20 is directed to an improved apparatus for the destructive distillation or pyrolysis of rubber to produce hydrocarbon and solid carbonaceous char. The claimed apparatus comprises a circulation loop for circulating a heat transfer gas from the distillation chamber through some means (e.g., a heat exchanger) for removing heat from the heat transfer gas and back into the distillation chamber into contact with the carbonaceous char to transfer heat from and thereby cool the char. The circulation loop through which the heat transfer gas is circulated dissipates waste heat at an effective rate and increases the processing capacity of the system by significantly reducing the period of time needed for a distillation chamber and

its contents to become sufficiently cool to allow the chamber to be opened and reloaded with a rubber charge.

Claim 19 is directed to an embodiment in which the destructive distillation of rubber is carried out in a system requiring one or more distillation chambers and comprising a circulation loop including a heat exchanger through which the heat transfer gas is circulated from the distillation chamber, through the heat exchanger, and back into the chamber. For example, in such an embodiment, the circulation loop in the system illustrated in Fig. 1 of the application when the contents of distillation chamber 3 are being cooled at the end of a distillation cycle may include line 31a, valve 93a, line 65, heat exchanger 9, line 66, blower 15, line 68, line 76a and distillation chamber 3.

Claim 20 is directed to an embodiment in which the destructive distillation of rubber is carried out in an apparatus comprising at least two distillation chambers operated in off-set, batchwise distillation cycles, and a circulation loop for circulating the heat transfer gas from the first distillation chamber, through the second distillation chamber and back into the first chamber so that heat is removed from the char in the first chamber and used to preheat a rubber charge in the second chamber. For example, in such an embodiment, the circulation loop in the system illustrated in Fig. 1 of the application when the contents of distillation chamber 3 are being cooled at the end of a distillation cycle may include line 31a, valve 90a, line 92b, distillation chamber 4, line 31b, valve 93b, line 65, heat exchanger 9, line 66, blower 15, line 68, line 76a and distillation chamber 3. By effectively utilizing the waste heat present in one of the distillation chambers at the end of a distillation cycle to preheat the cool rubber charge in the other

chamber, the apparatus defined in claim 20 reduces the energy requirements of the system.

The relevant teaching of Jarrell is discussed by applicant at page 2, line 6 to page 3, line 3 of the specification. Jarrell discloses a vacuum destructive distillation process and apparatus for recovering hydrocarbon fuel and carbon black from rubber tires. Jarrell describes the operation of two rubber distillation reactors in off-set, batchwise distillation cycles and the conservation of energy by using waste heat removed from one of the reactors during cooling to preheat the rubber charge in the other reactor. To achieve this, the two reactors are connected by a "valved pressure equalization line 21" capable of equalizing the pressure between the two sealed reactors (col. 8, lines 8-21). At the end of the distillation cycle in one of the reactors, a vacuum pump is employed to draw a vacuum in the other reactor containing a fresh charge of rubber feed and provide a pressure differential between the two reactors. The valve 21a in the pressure equalization line is then opened to produce a **one-way** flow of gas between the two reactors until the pressure is equalized. As a result of the gas flow, the reactor in which the distillation cycle has just been completed and the rubber char contained therein is cooled and a small amount of the waste heat transferred to the rubber feed in the other reactor. Although Jarrell achieves a certain degree of energy recovery, a circulation loop is not shown or contemplated and the one-way flow of gas and heat transfer essentially stops as soon as the pressure in the two reactors has equalized. As a result, the waste heat in the cooling reactor is not fully utilized in preheating the rubber charge in the other reactor, nor does the waste heat from the cooling reactor dissipate at an effective rate. Since considerable time must pass to allow the reactor and

its contents to cool before it can be opened and reloaded with a rubber charge, the processing capacity of the system is limited. Recognizing the inherent shortcomings in the disclosed system, Jarrell teaches introducing liquid nitrogen into the reactors in order to speed the cooling period (See col. 7, lines 31-33). Such measures add to the expense and complexity of the system.

The requirement of a circulation loop through which a heat transfer gas is circulated from a distillation chamber, through a heat sink or other means for removing heat from the heat transfer gas (e.g., a heat exchanger as called for in claim 19 or a second distillation chamber containing a rubber charge as called for in claim 20) **and back into the distillation chamber** is manifestly absent from the vacuum-operated system disclosed by Jarrell including a uni-directional pressure equalization line.

In view of the above, the invention defined in claims 19 and 20 is respectfully submitted as novel and patentable over the disclosure in Jarrell.

Rejections under 35 U.S.C. § 103(a)

Applicant respectfully requests reconsideration of the rejection of claims 21 and 22 under 35 U.S.C. § 103(a) as being unpatentable over Jarrell in view of U.S. Patent No. 4,619,147 to Yoshimura, et al. ("Yoshimura").

In order to establish a *prima facie* case of obviousness, it is incumbent upon the Office to show that the cited art teach or suggests all the claim limitations, that there is some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings and that there must be a reasonable expectation of success. Applicant respectfully submits that a *prima facie* case of

obviousness has not been established with respect to the invention defined in claims 21 and 22.

The invention of claim 21 is directed to an improved apparatus for the destructive distillation or pyrolysis of rubber to produce hydrocarbon and solid carbonaceous char. The apparatus includes a distillation chamber for holding a rubber charge, a heater associated with the distillation chamber for heating the rubber to a temperature sufficient to pyrolyze the rubber, distill a vapor comprising hydrocarbon and produce a solid carbonaceous char, a gas outlet for removing vapor comprising hydrocarbon from the chamber and a condenser for producing a liquid fraction comprising hydrocarbon from the vapor removed from the chamber. In accordance with the present invention, the apparatus of claim 21 further includes means for monitoring weight loss of the rubber charge in the chamber as a result of pyrolysis. Dependent claim 22 requires that the apparatus comprise a load cell as the weight loss monitoring means.

A difficulty encountered in Jarrell and other prior art rubber distillation systems is the inability to accurately determine the end point of rubber pyrolysis so as to consistently obtain a char of desired composition. **A means for monitoring weight loss, and specifically a load cell, solves this problem by providing the means to determine, based upon percentage reduction in weight of the rubber, the end point of the rubber pyrolysis to obtain the desired char.** In operation of the apparatus defined in claim 21, heating and distillation of the rubber charge contained in the distillation chamber continues until the volatile content of the char has been reduced to a desired level. More particularly, the claimed apparatus includes means for monitoring weight loss of the rubber charge as a result of

pyrolysis (e.g., one or more load cells positioned under the oven defining the distillation chamber so that the weight of the oven and its contents rests on the load cells) so that the heating of the rubber may be discontinued in response to the weight loss of the rubber or a function of the weight loss of the rubber.

As acknowledged in the Office action, Jarrell fails to teach or suggest an apparatus including a load cell or other means for monitoring the weight loss of the rubber as it is pyrolyzed.

Yoshimura discloses the construction of load cells in which the strain gage carrying portion of the load cell body and the housing or enclosure are not fixed together, but are instead separated by a gap for more accurate load measurement, while preventing flame propagation and spreading of an explosion from the load cell enclosure to other equipment. Nowhere does Yoshimura teach or suggest an apparatus including a load cell or other weight-monitoring device for measuring weight loss of a reactant as a reaction proceeds to determine end point, much less an apparatus for the destructive distillation of rubber including a load cell to monitor the weight loss of a rubber charge as called for in claim 21. Yoshimura teaches only that "a load cell which is part of equipment for treating explosive gases, such as acetone and coal gas, must be flame proof and of explosion-protected construction." (col. 1, lines 12-14). Such a vague reference to a system for "treating" explosive gases does not provide any motivation to modify the rubber pyrolysis system disclosed in the primary reference to include a load cell as a means for monitoring weight loss of the rubber charge, nor does it suggest the advantages made possible by the claimed apparatus in consistently determining the end point of rubber pyrolysis to reproducibly obtain a char of the desired composition. Accordingly, applicant respectfully submits that the invention

defined in claims 21 and 22 are patentable over Jarrell in view of Yoshimura.

Applicant respectfully requests reconsideration of the rejection of claims 26, 27 and 30 under 35 U.S.C. § 103(a) as being unpatentable over Jarrell in view of Yoshimura.

Claims 26 and 30 depend directly from independent claims 19 and 20, respectively, and require that the apparatus further comprise means for monitoring weight loss of the rubber in the distillation chamber(s) as a result of pyrolysis. Claim 27 depends from claim 26 and requires that the weight loss monitoring means comprise a load cell.

The shortcomings of the primary reference, Jarrell, with respect to the requirement of a circulation loop in independent claims 19 and 20 through which a heat transfer gas is circulated from a distillation chamber, through a heat sink or other means for removing heat from the heat transfer gas (e.g., a heat exchanger as called for in claim 19 or a second distillation chamber containing a rubber charge as called for in claim 20) and back into the distillation chamber cannot be overcome by resort to Yoshimura. Accordingly, applicant respectfully submits that a *prima facie* case of obviousness is lacking as to the invention defined in dependent claims 26, 27 and 30.

Applicant respectfully requests reconsideration of the rejection of claims 28, 29 and 32-35 under 35 U.S.C. § 103(a) as being unpatentable over Jarrell in view of U.S. Patent No. 4,881,947 to Parker, et al. ("Parker").

Claims 28 and 29, 32 and 33 and 34 and 35 depend directly or indirectly from independent claims 19, 20 and 21, respectively, and further require that the heater associated with the distillation chamber(s) comprise radiant heating tubes in which a

mixture of a hydrocarbon and an oxygen-containing gas is combusted.

Parker discloses a continuous rotary kiln system used in gasification of a variety of organic solid waste materials. The system includes radiant tubes in which a portion of the product gas is combusted by burners to provide the heat source for the reaction chamber in the rotary kiln.

The shortcomings of the primary reference, Jarrell, with respect to the requirement of a circulation loop in independent claims 19 and 20 through which a heat transfer gas is circulated from a distillation chamber, through a heat sink or other means for removing heat from the heat transfer gas (e.g., a heat exchanger as called for in claim 19 or a second distillation chamber containing a rubber charge as called for in claim 20) and back into the distillation chamber cannot be overcome by resort to Parker. Accordingly, applicant respectfully submits that a *prima facie* case of obviousness is lacking as to the invention defined in dependent claims 28 and 29 and 32 and 33.

Similarly, the acknowledged shortcoming of the primary reference, Jarrell, with respect to the requirement of a weight loss monitoring means cannot be overcome by resort to Parker. Accordingly, applicant respectfully submits that a *prima facie* case of obviousness is lacking as to the invention defined in dependent claims 34 and 35.

On pages 4 and 5 of the Office action, claim 31 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Jarrell in view of Yoshimura and Parker. Claim 31 depends directly from claim 30 and indirectly from claim 20 and requires that the apparatus include load cells as the weight loss monitoring means associated with each of the distillation chambers. However, the comments in support of the rejection indicate that the Examiner

has misinterpreted claim 31 as requiring the heater called for in the apparatus comprise radiant heating tubes in which a mixture of a hydrocarbon and oxygen-containing gas is combusted (See claim 32). In any event, applicant respectfully submits that the invention defined in claim 30 and further dependent claim 31 is patentable over the cited art for the reasons set forth above.

In view of the foregoing, favorable reconsideration and allowance of all pending claims are respectfully solicited.

The Commissioner is requested to charge any fee deficiency in connection with this response to Deposit Account No. 19-1345.

Respectfully submitted,

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